INVESTIGATOR'S ANNUAL REPORT

National Park Service

All or some of the information provided may be available to the public

Reporting Year: 2005	**Park:** Shenandoah NP
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Permit#:
SHEN-2004-SCI-0006

Park-assigned Study Id. #:
SHEN-00292

Project Title:
Effects of stream water chemistry on mercury concentrations in brook trout in Shenandoah National Park.

Permit Start Date: May 01, 2004	**Permit Expiration Date** Sep 30, 2005
Study Start Date: May 01, 2004	**Study End Date** Sep 30, 2005

Study Status:
Completed

Activity Type:
Research

Subject/Discipline:
Air Pollution Effects

Objectives:

Mercury is a toxic element that naturally occurs in aquatic systems in very low concentrations. Past human use of the metal for industrial and agricultural purposes has resulted in serious contamination of many surface waters. Even in remote, relatively pristine areas where direct anthropogenic inputs are lacking, long-range atmospheric transport of Hg from fossil fuel combustion and other sources has led to increased concentrations in freshwater systems and biota. Morover, past research indicates that mercury accumulation by biota is not strongly correlated with the amount or form of mercury inputs. Rather, physical and chemical characteristics of the aquatic systems receiving inputs seems to be more important determinant of accumulation patterns by biota.

The objectives of this research were to 1) evaluate the potential threat of mercury to humans that consume fish caught in the park, and 2) determine the extent to which variation in bedrock geology and water chemistry influence mercury accumulation in brook trout, the primary game fish in the park.

Findings and Status:

In large measure, our data suggests mercury does not pose a significant human health threat in SNP. The primary fish species taken for consumption from SNP streams is brook trout, and mercury concentrations in brook trout were very low relative to EPA recommended consumption limits. However, mercury concentrations observed for some other species may suggest some cause for concern. In particular, brown trout, another important game species that is often taken for food were found to have high mercury concentrations relative to EPA recommended consumption limits. American eel

also had high mercury concentrations but eels are not frequently taken for food from SNP streams. Two other food species commonly taken in the park, smallmouth bass and rock bass, were also found to have relatively high mercury concentrations, though only about half as high as brown trout. Thus, it may be prudent for park management to consider implementing some management actions, such as posting health advisories, for some of these species.

From assessments of spatial patterns of mercury accumulation in brook trout, we conclude that the predominant bedrock type underlying streams was an important predictor of mercury accumulation rates in fish. Observed patterns were essentially in accordance with our a priori hypothesis. That is, mercury accumulation rates were highest in streams underlain by siliciclastic bedrock, lowest in streams underlain by basaltic bedrock, and intermediate in streams underlain by granitic bedrock. Moreover, these patterns suggest that mercury methylation in streams is sensitive to many of the same water chemistry variables that have been shown to influence mercury accumulation in fish in lake ecosystems. In particular, pH has been found to be indirectly related to mercury methylation and biotic uptake in lakes. In this study we found that pH was strongly correlated with bedrock geology, and mercury accumulation rates varied among bedrock types. These patterns suggest that mercury levels in fish may be expected to increase if acidic precipitation continues in the region.

In contrast to bedrock type, other factors examined were not particularly informative or patterns were confusing. For example, neither sulfates nor nitrates were particularly informative in terms of explaining variation in fish mercury concentrations. Likewise, although elevation explained a significant amount of variation in mercury accumulation within two of three bedrock types, the effect of elevation was opposite for the two types. This suggests that it was not elevation per se that was important but some factor that correlated with elevation within bedrock types but not between bedrock types. One possible explanation that may be consistent with the observed pattern relates to the distribution of wetland habitats. Compared to other aquatic habitats like streams and lakes, wetlands are known to be hotspots of mercury methylation. Thus, it could be that wetland habitats may have been distributed differently between the two rock types. That is, in some rock types wetland habitats may tend to be located at higher elevations, perhaps spring seeps in saddle areas where headwaters originate; whereas in streams underlain by other rock types, wetlands habitats may be more prevalent at lower elevations, perhaps in riparian areas. Clearly additional research is needed in this area.

For this study, were one or more specimens collected and removed from the park but not destroyed during analyses?

No

Funding provided this reporting year by NPS:	**Funding provided this reporting year by other sources:**
0	13000

Fill out the following ONLY IF the National Park Service supported this project in this reporting year by providing money to a university or college

Full name of college or university:	**Annual funding provided by NPS to university or college this reporting year:**
n/a	0